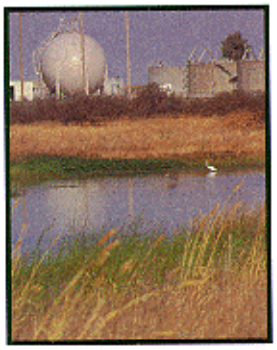
Customer Profile

Pump and compressor wastewater treatment p



by Tony Palmer
Control Systems Supervisor
Sacramento Regional Wastewater Treatment Plant

and J. P. Morris
Manager of Mechanical Maintenance
Sacramento Regional Wastewater Treatment Plant

The Sacramento Regional Wastewater Treatment Plant in Sacramento County, California is a modern and innovative sanitation facility in the western United States. Much of its success over the past ten years has been due to a rigorous Predictive Maintenance program. A study by the Mechanical Maintenance Department estimated that this program saves the plant at least $500,000 per year.

The process

The plant is operated by the Sacramento Regional County Sanitation District (SRCSD). Each day, it processes over 140 million gallons of wastewater for more than one million customers. The wastewater is treated by an activated sludge process (Figure 1).

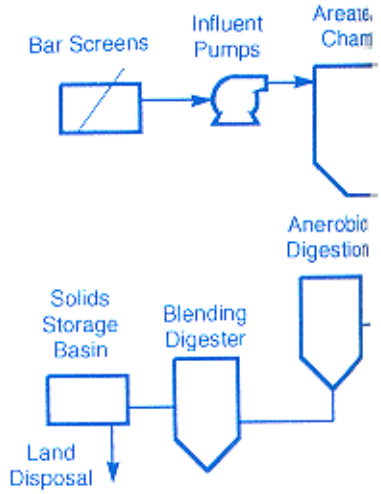
Incoming wastewater (influent) is first screened to remove large objects. Then it flows into primary sedimentation tanks, which settle out most of the remaining solid material. Next it enters carbonaceous oxidation tanks, where it is infused with oxygen and naturally-occurring microscopic organisms. These organisms digest organic matter in the wastewater; oxygen speeds the process. The organisms quickly fatten, then settle out in secondary clarifier tanks. The remaining, clarified wastewater is disinfected with chlorine, then dechlorinated, and discharged into the Sacramento River.

The settled sludge from the bottom of the secondary sedimentation tanks is pumped to digester tanks. It is again treated with micro-organisms, to reduce the amount of solid matter. Then, the biosolids are stored in a Solids Storage Basin for up to five years. Eventually, the biosolids are pumped to a dedicated land disposal site and injected below the soil surface. In the future, SRCSD envisions recycling specially-treated biosolids for use as an agricultural soil amendment, fertilizer and landscape compost. SRCSD will soon begin growing barley on test plots to demonstrate that biosolids make an excellent fertilizer.

Odor is very well-controlled. Most of the plant's tanks, pumps, motors and pipes are underground, so very little gas escapes. Gasses from the covered process units are vented through Odor Removal Towers. There the gas passes through chemical scrubbers or mobile activated carbon, before it is released into the atmosphere. Methane gas from the digester units will soon fuel an onsite cogeneration plant. A cogeneration plant provides the plant with backup power in case of a major power failure.

The plant

The Sacramento Regional Wastewater Treatment Plant is comprised of fourteen process areas located on 900 acres of a 3400 acre site. Most of the plant is located underground, connected by over three miles of clean, well-lit tunnels. Seventy tanks hold millions of gallons of wastewater at several stages of treatment.



Simplified diagram of a

Most of the plant's machinery consists of pumps, compressors and blowers. The plant has approximately 768 pumps. The largest are the five influent and four effluent pumps, which are 54-inch diameter, vertically-mounted, centrifugal pumps driven by 1500 hp motors. The smallest monitored for vibration are the 48 Secondary Sedimentation Tank Return Activated Sludge Pumps, which are driven by 50 hp motors. The plant's approximately 70 compressors include four Liquid Oxygen Plant Air Compressors, (two driven by 3300 hp motors and two by 1700 hp motors), and Sludge Gas Recirculation Compressors driven by 100 hp motors. The plant has three 1700 hp blowers.

The plant is operated by mini-com-

monitoring saves a ant $500,000 a year

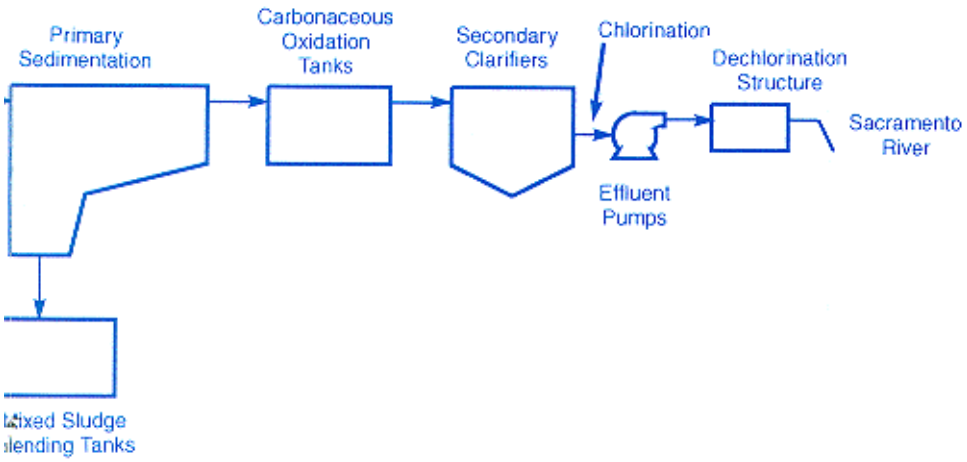


Figure 1
d sludge process at the Sacramento Regional Wastewater Treatment plant.

puters in each of fourteen Area Control Centers (ACC). The ACC computers are connected to two larger computers at the Plant Process Center (PPC). Two operators at the PPC monitor all fourteen Area Control Centers.

Predictive Maintenance Program

When the plant opened in 1982, it used a periodic maintenance program. In 1986, Richard Glacken (now retired) researched Predictive Maintenance programs. With our help, he established a comprehensive Predictive Maintenance program that has proven extraordinarily successful.

The Mechanical Maintenance department began by ranking each machine according to its importance. This ranking became the basis for a regular vibration data collection schedule. The most critical machines are continuously monitored, while others are monitored monthly, quarterly or semi-annually. Some of this data is available to the Process Control Computers all of it is part of a maintenance database. Maintenance personnel also began collecting baseline data on all new and rebuilt machines. Oil analysis supplements the vibration data.

The Predictive Maintenance database showed that much of the plant's regularly scheduled machine maintenance was unnecessary. Instead, maintenance personnel found that vibration data trends could accurately indicate when machines required service. More importantly, maintenance personnel discovered that they could increase the lifespan of most machines by balancing and aligning them more accurately than specified by the OEMs.

The program's success

SRCSD's Predictive Maintenance program's success is evident in the small number of machine failures that have occurred since the program began. Since 1987, SRCSD has had only two machine failures, and the monitoring equipment helped minimize damage in both cases.

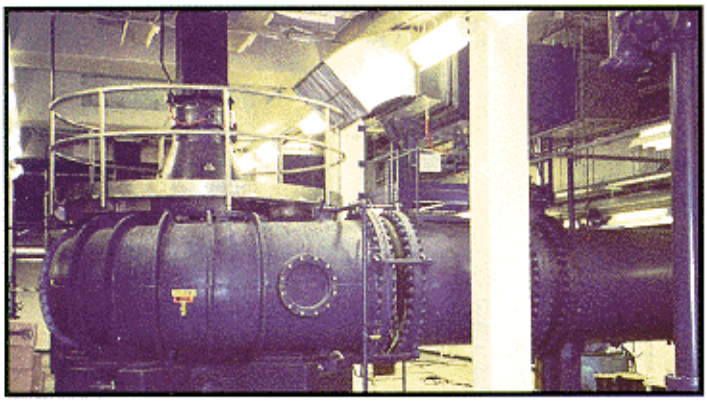
In the first instance, a three-stage oxygen compressor that was coasting down was restarted before it had come to a stop. Although the coupling was damaged and a hub cracked, a Bently Nevada 3300 Monitoring System shut it down before more extensive damage could occur. The motor was subsequently rebuilt, and a system was installed to prevent operators from restarting the motor while it is rotating.

The second machine saved was a Channel Aeration Air (CAA) blower, which keeps solids from settling. A Bently Nevada 7200 Monitoring System shut down the CAA blower on high vibration, before serious damage could result. The only damage it suffered was a broken keyway.

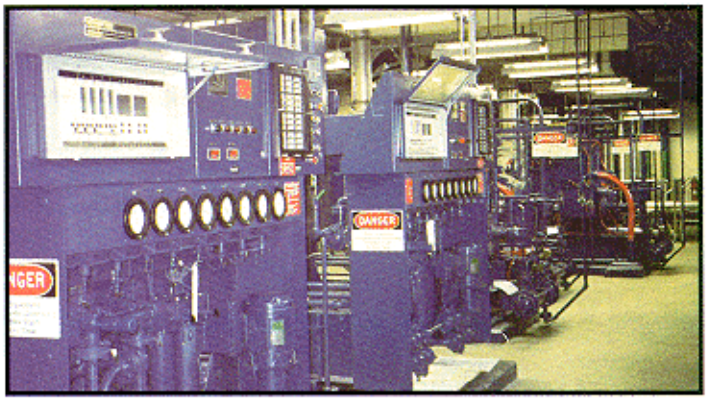
The Predictive Maintenance program also helps us plan for periods of increased activity. The Sacramento area is home to several canneries, which are busiest from July through September. During most of the year, industrial flows account for approximately 25% of the plant's load. In the canning season, it rises to 40%. Prior to the canning season, Mechanical Maintenance personnel review the Predictive Maintenance database to identify machines that may fail under increased load. Of particular importance are the compressors used in oxygen production.

During the canning season, the influent's organic load greatly increases. The carbonaceous oxygen system, which digests organic material, relies on oxygen from the oxygen production facility. The plant's automated data collection system gives us confidence that critical air compressors will operate throughout the canning season.

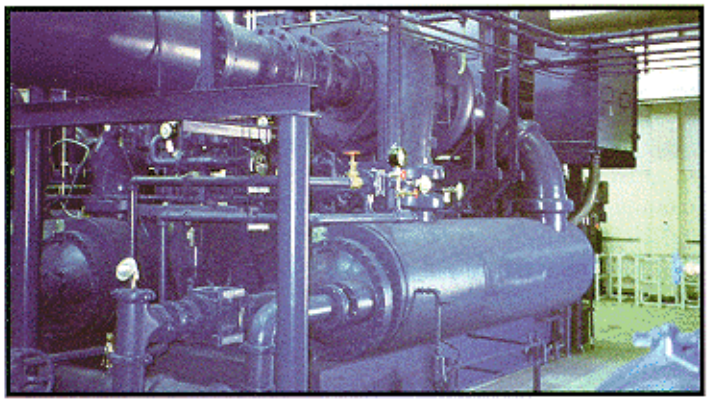
Another advantage of automated data collection is that trend data can be analyzed to predict the lifespans of older equipment. This season, we are closely monitoring a Medium Pressure Sludge Gas (MSG) compressor, which removes gas from the digester tanks. It is running at maximum capacity, just below its surge point, to supply the cogeneration plant with methane gas. Soon, it will be replaced by a larger compressor. Until then, we watch it closely. Experience has shown us that, when this compressor's vibration reaches a certain level, the bearings have one month of service left.



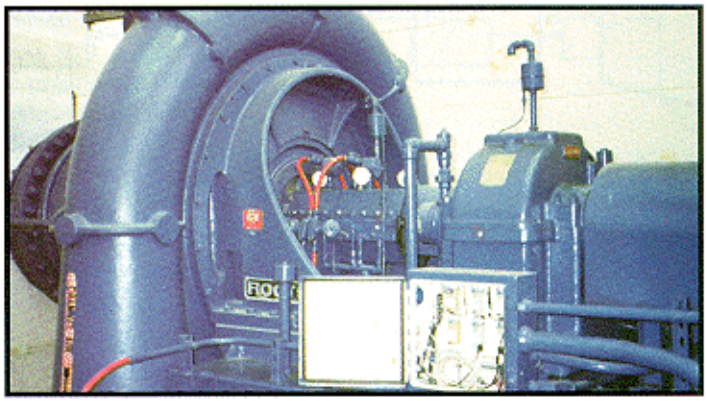
Effluent pump driven by 1500 hp electric motor.



Carbonaceous oxidation tank blowers.



Air compressor in oxygen plant driven by 3300 hp motor.



Channel aeration air blower.

How Bently Nevada has helped

The plant's original vibration monitoring equipment, built by another manufacturer, suffered from many false alarms. Several years ago, the Mechanical Maintenance Section retrofitted some machines with Bently Nevada monitors, which eliminated the false alarms. That success convinced SRCSD to standardize on Bently Nevada equipment; since then we have been replacing the original vibration monitoring equipment with Bently Nevada 3300 Vibration Monitoring Systems, as our budget allows.

Today, Bently Nevada 3300 Monitoring Systems collect data from over 700 machine points on 36 machine trains. The 3300 System is Bently Nevada's industry-standard continuous monitoring system. The 3300 Systems' inputs come from Bently Nevada Velomitor® Piezo-velocity sensors, Keyphasor® transducers and proximity transducers. The 3300 Systems' proportional data (4 to 20 mA) outputs are connected to the Process Control Computers at the fourteen Area Control Centers. We use a Bently Nevada Snapshot System for manual data collection. Including manually collected data, the Mechanical Maintenance Department monitors vibration at 2100 points on the plant's motors, pumps and compressors.

Technicians in the Mechanical Maintenance Department use a Bently Nevada ADRE® 3 System to perform detailed investigations into machine performance. The ADRE 3 diagnostic system acquires vibration data during machine startup, shutdown and at constant speed, and plots the data in several formats that are essential for accurate machinery diagnostics. Several of SRCSD's employees have attended Bently Nevada training courses on the ADRE 3 and Snapshot Systems.

SRCSD has standardized on Bently Nevada equipment because of the equipment's performance and comprehensive training and support. Standardization also allows us to consolidate our spare parts inventory.

Cost savings

SRCSD now schedules machine maintenance only when it is absolutely necessary. A few years ago, the Maintenance Department studied the performance of the predictive maintenance program. The result: the plant saved $250,000 each year in deferred maintenance on the 50% of the plant's machinery that was studied. J.P. Morris estimates that, overall, the plant saves over $500,000 each year by carefully monitoring and managing pumps, compressors and blowers.

Conclusion

SRCSD's Predictive Maintenance program has been successful, with significant savings in planned maintenance and unplanned shutdowns. In eight years of monitoring and managing hundreds of pumps, compressors and blowers, only two machines have failed, in both cases with minimal damage. This remarkable achievement is a tribute to the plant's Predictive Maintenance program.■